ISSN 2348 – 8034
Impact Factor- 3.155

COMPRESSIVE STRENGTH STUDY OF SELF-CURING CONCRETE AND CONVENTIONAL CONCRETE

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ABSTRACT

The present study involves the use of superabsorbent polymer (SAP) in concrete which helps in self-curing and helps in better hydration. In the present study, the effect of superabsorbent polymer (SAP) on compressive strength by varying the percentage of SAP by weight of cement from 0.2%, 0.3% and 0.4% were studied for both mixes M20 and M30, and it is compare with same grade of concrete which is made by conventional method. It was found that SAP could help in self-curing by giving strength on par with conventional curing.

Keywords- *Concrete, Self-curing concrete, Curing, Self-curing, Self-curing Agent (Super Absorbent Polymer).*

I. INTRODUCTION -

Concrete is most widely used construction material due to its good compressive strength and durability. Depending upon the nature of work the cement, fine aggregate, coarse aggregate and water are mixed in specific proportions to produce plain concrete. Plain concrete needs suitable atmosphere by providing moisture for a minimum period of 28 days for good hydration and to attain desired strength. Any lack in curing will badly affect the strength and durability of concrete. Self-curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence paucity of water in arid areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete.

Proper curing of concrete structures is important to meet performance and durability requirements. In conventional curing this is achieved by external curing applied after mixing, placing and finishing. Self-curing or internal curing is a technique that can be used to provide additional moisture in concrete for more effective hydration of cement and reduced self-desiccation. When this water is not readily available, significant autogenously deformation and (early-age) cracking may result. Due to the chemical shrinkage occurring during cement hydration, empty pores are created within the cement paste, leading to a reduction in its internal relative humidity and also to shrinkage which may cause early-age cracking.

II. EXPERIMENTAL DELAILS -

Materials Used -Material used in the study were cement(PPC),fine aggregate (river sand passing through 4.75 mm),coarse aggregate, SAP, and Water. The Table no. 01gives the properties of SAP.

A brief description of the material used in this research work is presented below.

*Cement:*Portland pozzolona cement (ACC)with specific gravity 3.10, available in local market was used in this entire investigation.

*Fine Aggregate:*Locally available river sand conforming to Indian standard (Zone-II).

*Coarse Aggregate:*Locally available quarry stone in good strength.

*Water:*Ordinary potable water without acidity and alkaniety available in the MaterialTesting laboratory was used.

*Super Absorbent Polymer:*The common SAPs are added at rate of 0.2,0.3 and 0.4 wt % of cement. The SAPs are covalently cross-linked. They are Acryl amide/acrylic acid copolymers. One type of SAPs are suspension polymerized, spherical particles with an average particle size of approximately 1.00 mm; another type of SAP is solution polymerized and then crushed and sieved to particle sizes in the range of 0.50–2.00 mm. The size of the swollen SAP particles in the cement pastes and mortars is about three times larger due to pore fluid absorption. The swelling time depends especially on the particle size distribution of the SAP. It is seen that more than 50% swelling occurs within the first 5 min after water addition. Image of SAP (Fig.-01)

ISSN 2348 – 8034
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Fig.01 – SAP

Advantages of Using Sap (Internal Curing Agent):-

- To overcome from deficiencies of external curing generated by both human and hydration.
- To eliminate shrinkage (most probably autogenousshrinkage).
- Provides moisture contents to keep continue hydration of cement.
- Increase/maintain the strength of concrete if the optimum dosage of self-curing admixtures is used.
- When properly applied, provides a premium-grade film, which optimizes water retention.
- Protects by reflecting the sun rays to keep the concrete surface cooler and prevent excessive heat build-up, which can cause thermal cracking.
- Improves resistance to the abrasion and corrosive actions of salts and chemicals.

Table 1: Properties of Super Absorbent Polymer

Form	Dry– Crystalline white powder / granules
Particle size	1 mm(Average)
Water absorption with distilled water	150 g for 1 g of SAP
pH of absorbed water	Neutral
Density	1.08
Bulk density	0.85
Hydration / Dehydration	Reversible
Decomposition in sun light	6 months
Available water	95% approx.

III. EXPERIMENTAL PROGRAMME -

The experimental program was designed to investigate the strength of self curing concrete by adding superabsorbent polymer(SAP) @ 0.2-0.4% by weight of cement to the concrete. The 0% of SAP concrete is prepared by conventional method. The experimental program was aimed to study the compressive strength. To study the above properties mixes M20 and M30 were considered. The scheme of experimental program is given in Table No.2

Table 2: Details of specimens cast

Sr. No.	Test	Cubes Sets	Grade	Cube Name	% Of SAP	7 Days	28 Days
1	Compressive Strength	A	M20	A1	0%	3	3
				A2	0.20%	3	3
				A3	0.30%	3	3
				A4	0.40%	3	3
		B	M30	B1	0%	3	3
				B2	0.20%	3	3
				B3	0.30%	3	3
				B4	0.40%	3	3
				TOTAL		24	24

*The size of each cube is 150 x150 x150 mm for compressive strength.

ISSN 2348 – 8034
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Fig.02 – Compressive Strength Testing Machine

IV. EXPERIMENTAL RESULTS AND DISCUSSION-

For cube specimen total two sets of cubes A (A1,A2,A3and A4) and B (B1,B2,B3 and B4) were tested for their compressive strength for different proportions of SAP such as A sets for M20 (0%,0.2%,0.3% and 0.4% of SAP by weight of cement) andB sets for M30 (0%,0.2%,0.3% and 0.4% of SAP by weight of cement) respectively. The 0% of SAP concrete is prepared by conventional method. It was observed that the specimen sets A3 and B3 have improved maximum compressive strength in 28 days.

Fig.03 – Compaction of concrete (vibration)

Fig.04 – testing compressive strength

V. RESULTS -

The compressive strength values at 7 and 28 days of concrete are shown in Table no.3 and Table no.4.There is an increase in compressive strength of sets A3 and B3. All other concrete mixes containing SAP show a variation in strength with the increase in SAP content.

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Result of compressive strength testing for 7 days showing in Table 3:

Grade	M20			M30		
Days	7days			7 days		
% of SAP	Cube sets	Compressive strength (N/mm2)	Average Compressive strength (N/mm2)	Cube sets	Compressive strength (N/mm2)	Average Compressive strength (N/mm2)
0%	A1	18.67	19.11	B1	27.56	27.41
		19.56			26.67	
		19.11			28.00	
0.2%	A2	19.11	19.56	B2	27.11	27.41
		19.56			27.56	
		20.00			27.56	
0.3%	A3	20.89	20.89	B3	28.44	28.74
		20.44			28.89	
		21.33			28.89	
0.4%	A4	20.00	20.00	B4	28.00	27.85
		19.56			27.56	
		20.44			28.00	

Result of compressive strength testing for 28 days showing in Table 4:

Grade	M20			M30		
Days	28days			28 days		
% of SAP	Cube sets	Compressive strength (N/mm2)	Average Compressive strength (N/mm2)	Cube sets	Compressive strength (N/mm2)	Average Compressive strength (N/mm2)
0%	A1	26.67	27.11	B1	38.67	38.81
		27.56			38.67	
		27.11			39.11	
0.2%	A2	27.56	27.26	B2	38.22	38.22
		27.11			37.78	
		27.11			38.67	
0.3%	A3	28.44	28.89	B3	41.33	40.30
		29.33			39.56	
		28.89			40.00	
0.4%	A4	27.56	27.41	B4	38.67	39.11
		27.11			39.56	
		27.56			39.11	

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VI. DISCUSSION ON RESULTS-

Tables show the results of compressive strength experimental investigation on the behaviour of axially loaded specimens. Specimen strengthened with replacing different percentage of SAP. From the result for 7 days and 28 days, specimen setsA3 and B3 are given the effective results compare to conventional method cube setsA1 and B1 for compressive test. The all cube results in graph form in below.

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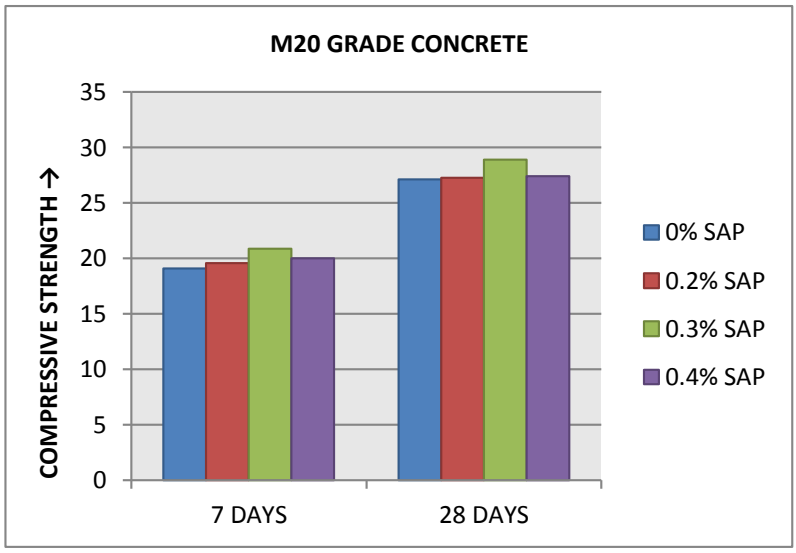
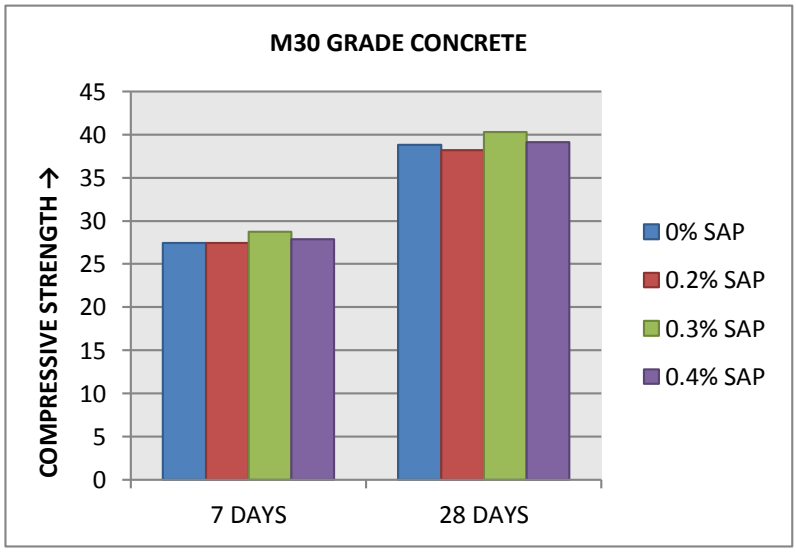


Graph 1 – Showing the variation of the compressive strength in M 20 grades concrete



Graph 2 – Showing the variation of the compressive strength in M 30 grades concrete

VII. CONCLUSIONS-

Super Absorbent Polymer was used as self-curing agent. M20 and M30 grade of concrete is adopted for the investigation. Based on the experimental investigation carried out, the following conclusions were drawn:

1. The optimum dosage is 0.3%.Addition of SAP leads to a significant increase of Compressive strength.
2. The Self-cured concrete using SAP was more economical than conventional cured concrete.

Compressive Strength ResultsFor 7 Days:-

- Sets A2 increase the strength 2.35% compare to sets A1 and sets A3 increase the strength 9.31% compare to sets A1 and sets A4 increase the strength 4.66% compare to sets A1, sets A1 is prepared by the conventional method.
- Sets B2 have same strength compare to sets B1 and sets B3 increase the strength 4.85% compare to sets B1 and sets B4 increase the strength 1.61% compare to sets B1, sets B1 is prepared by the conventional method.
- Sets A3 and B3 have more compressive strength compare to all other sets in same grade.

Compressive Strength ResultsFor 28 Days:-

- Sets A1 and Sets A2 have the same strength and sets A3 increase the strength 6.57% compare to sets A1 and sets A4 increase the strength 1.11% compare to sets A1, sets A1 is prepared by the conventional method.
- Sets B2 decrease the strength 1.52% compare to sets B1 and sets B3 increase the strength 3.84% compare to sets B1 and sets B4 increase the strength 0.77% compare to sets B1, sets B1 is prepared by the conventional method.
- Sets A3 and B3 have more compressive strength compare to all other sets in same grade but B2 sets show very less compressive strength compare to all other sets in same grade.

From the study it can be concluded that the specimen can be used with SAP to increase their strength to a great extent. The 0.3% SAP specimens to increase the result in this testcompare to the 0%,0.2% and 0.4% SAP specimens. This material may be used inRCC compression members and pre-stress concrete. This material is used where water problem presence in civil engineering construction.

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